US009456961B2

(12) **United States Patent**
Duineveld et al.

(10) **Patent No.: US 9,456,961 B2**
(45) **Date of Patent: Oct. 4, 2016**

(54) **TEAT**

(75) Inventors: **Paulus Cornelis Duineveld**, Drachten (NL); **Carolien Willemijn Geijzendorffer**, Mussel (NL); **Fokke Roelof Voorhorst**, Drachten (NL); **Johannes Tseard Van Der Kooi**, Drachten (NL)

(73) Assignee: **KONINKLIJKE PHILIPS N.V.**, Eindhoven (NL)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 804 days.

(21) Appl. No.: **12/863,223**

(22) PCT Filed: **Jan. 20, 2009**

(86) PCT No.: **PCT/IB2009/050198**

§ 371 (c)(1),
(2), (4) Date: **Jul. 16, 2010**

(87) PCT Pub. No.: **WO2009/093173**

PCT Pub. Date: **Jul. 30, 2009**

(65) **Prior Publication Data**

US 2010/0308001 A1 Dec. 9, 2010

(30) **Foreign Application Priority Data**

Jan. 25, 2008 (EP) 08150657

(51) **Int. Cl.**
A61J 17/00 (2006.01)
A61J 11/00 (2006.01)
A61J 11/04 (2006.01)

(52) **U.S. Cl.**
CPC ***A61J 11/005*** (2013.01); ***A61J 11/045*** (2013.01)

(58) **Field of Classification Search**
CPC A61J 11/00; A61J 11/045; A61J 11/005; A61J 11/0035; A61J 11/0045; A61J 11/006; A61J 11/0065; A61J 11/001; A61J 11/0015; A61J 1/003; A61J 11/0055; A61J 17/00; A61J 17/007; A61J 17/02; A61J 11/007; A61J 11/02
USPC 606/234–236; 128/848; D24/194; 215/11.1–11.5
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

2,366,214 A		1/1945	Ramaker	
4,505,398 A		3/1985	Kesselring	
4,623,069 A	*	11/1986	White	215/11.1
5,300,089 A	*	4/1994	Sassin	606/236
6,241,110 B1		6/2001	Hakim	
6,699,264 B1		3/2004	Rohrig	
6,863,681 B2	*	3/2005	Dickerson	606/235
6,968,964 B2	*	11/2005	Gilmore	215/11.1

(Continued)

FOREIGN PATENT DOCUMENTS

EP	2191808 A2	*	6/2010
GB	2215318 A	*	9/1989
WO	9704736 A1		2/1997

OTHER PUBLICATIONS

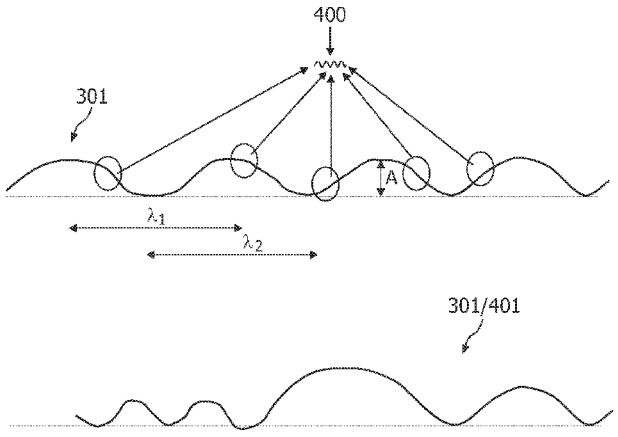
MAnuskiatti et al. "Influence of age, anatomic site and race on skin roughness and scaliness", Dermatology, 196, 401-407.*

Primary Examiner — Jonathan Miles
Assistant Examiner — Kendra Obu

(57) **ABSTRACT**

A teat includes a stem and a nipple, in which a structured area has an undulating surface on at least a partial region of the stem or nipple. The surface roughness of the undulating surface being greater than 100 μm.

4 Claims, 8 Drawing Sheets



(56) **References Cited**

U.S. PATENT DOCUMENTS

7,122,045	B2	10/2006	Randolph	
2004/0182813	A1	9/2004	Gilmore	
2004/0220618	A1	11/2004	Rohrig	
2005/0082301	A1*	4/2005	Verbovszky	220/717
2006/0069409	A1*	3/2006	Morris	A61J 17/00 606/234
2006/0201901	A1*	9/2006	Sabree et al.	215/11.1
2007/0068890	A1*	3/2007	Rohrig	215/11.1
2007/0208380	A1*	9/2007	Ebner	A46B 9/005 606/235

* cited by examiner

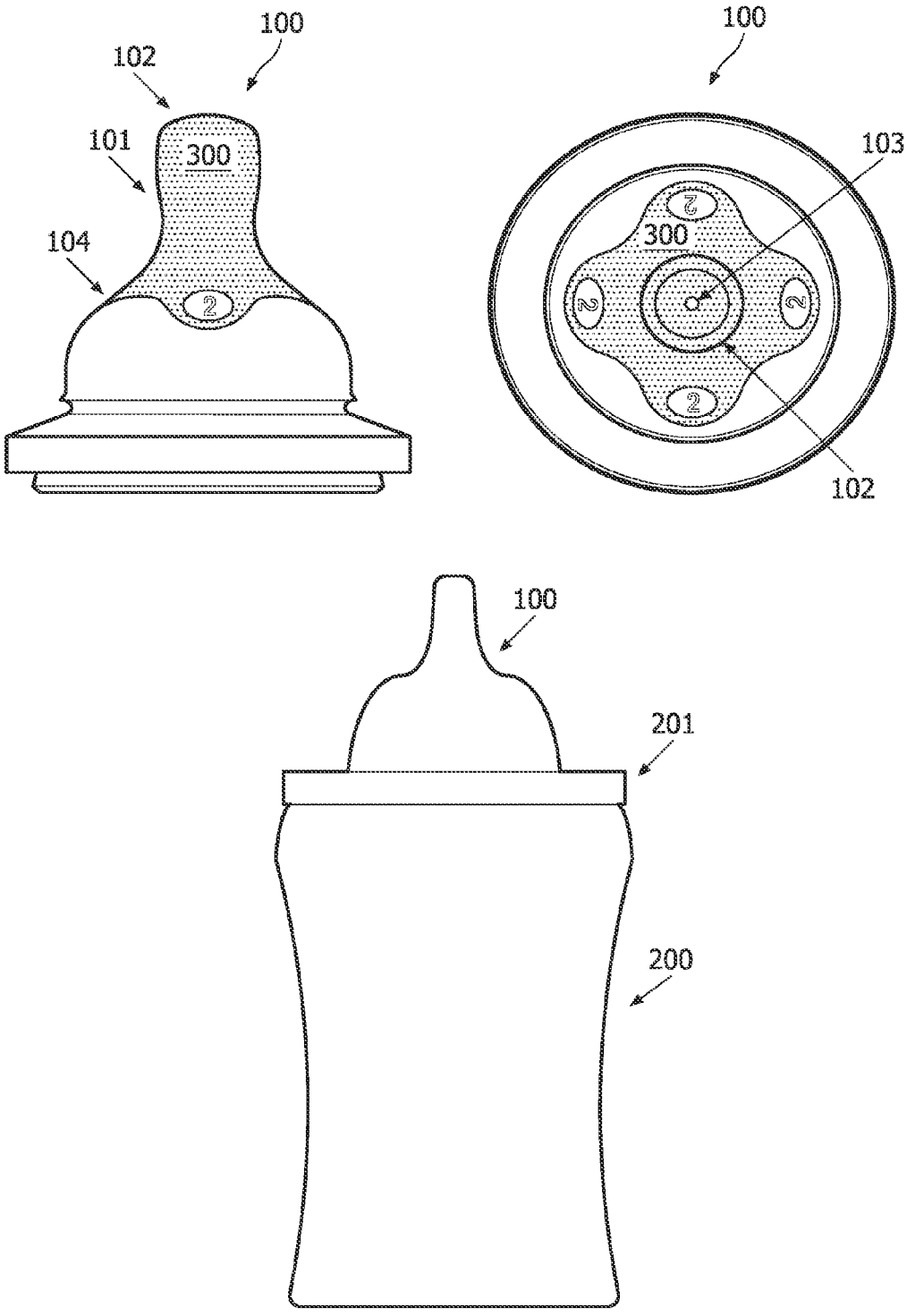


FIG. 1

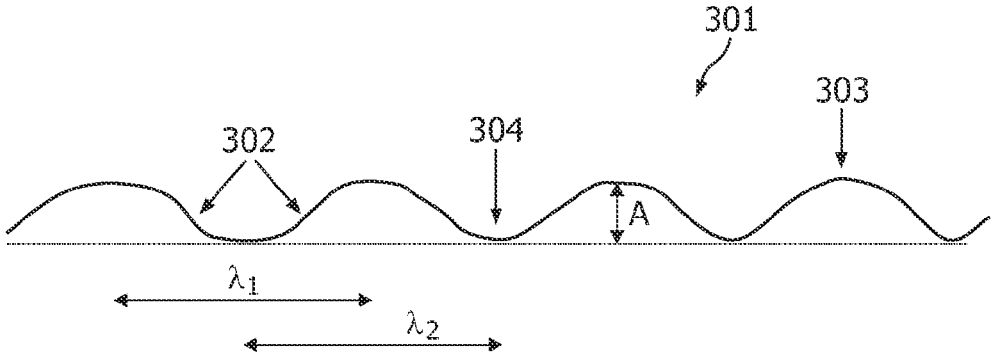

301
303
302
304
A
λ_1
λ_2

FIG. 2

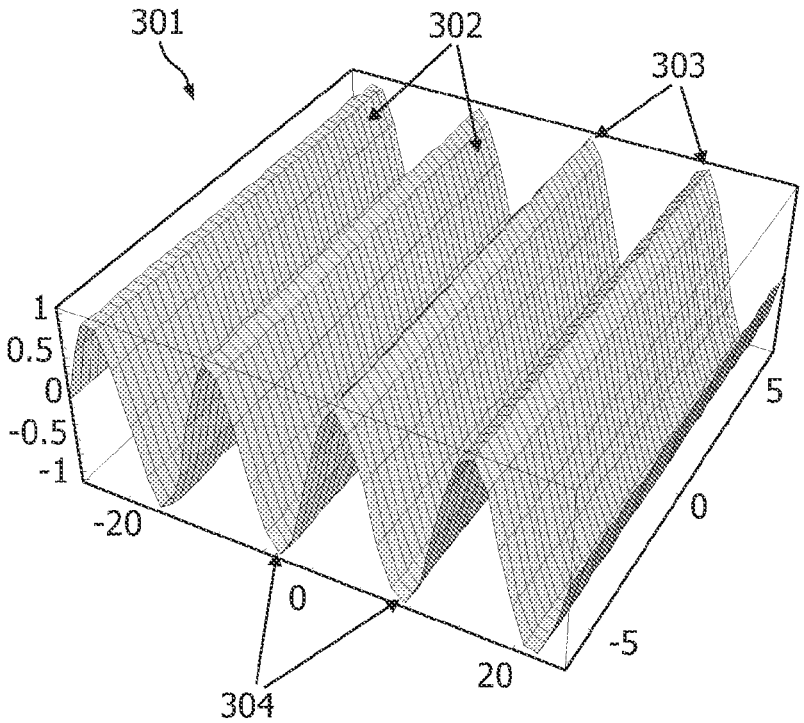

301
302
303
1
0.5
0
-0.5
-1
-20
0
20
304
5
0
-5

FIG. 3

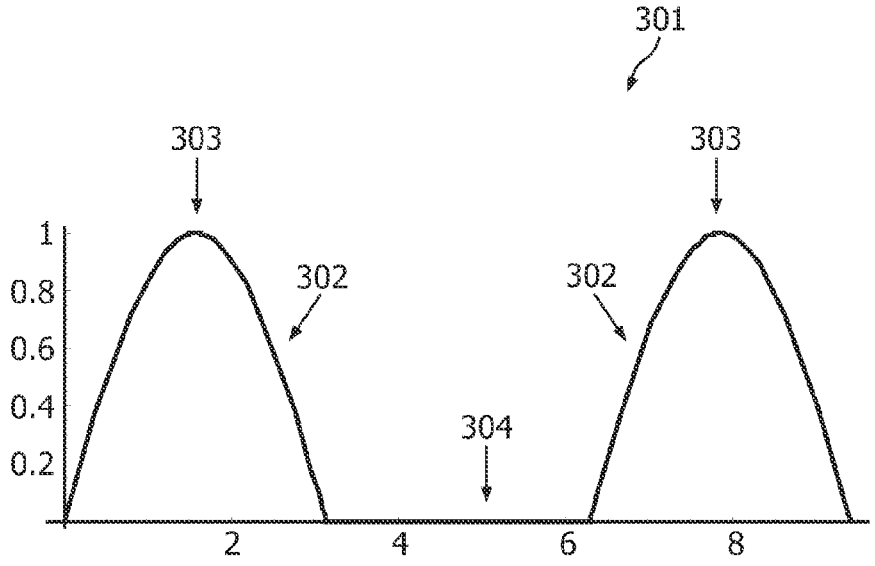

301
303
303
1
0.8
0.6
0.4
0.2
302
302
304
2
4
6
8

FIG. 4

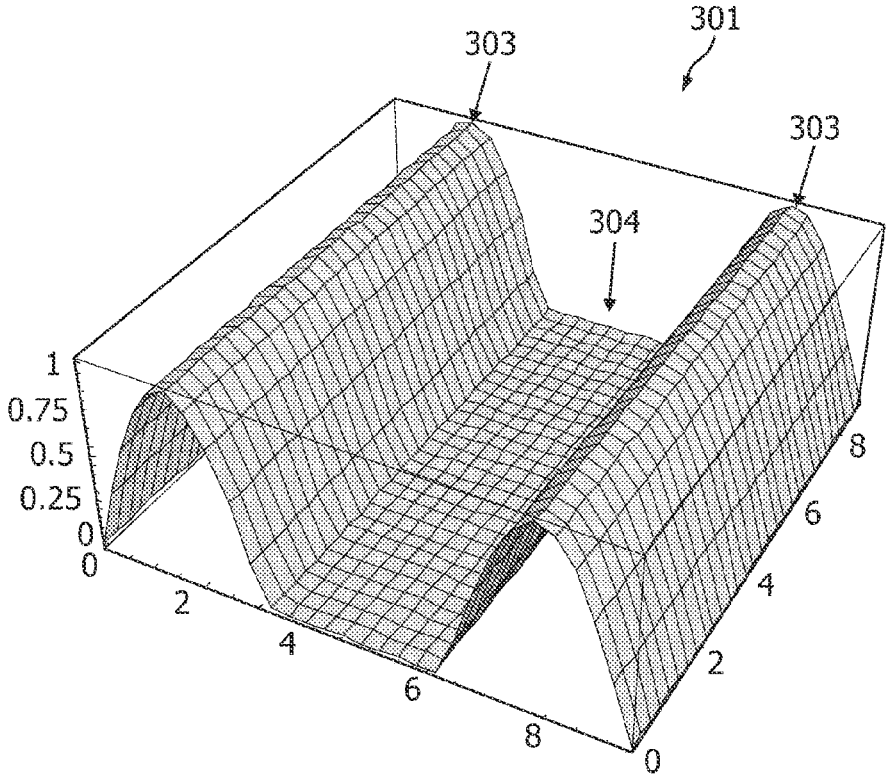

301
303
303
304
1
0.75
0.5
0.25
0
0
2
4
6
8
0
2
4
6
8

FIG. 5

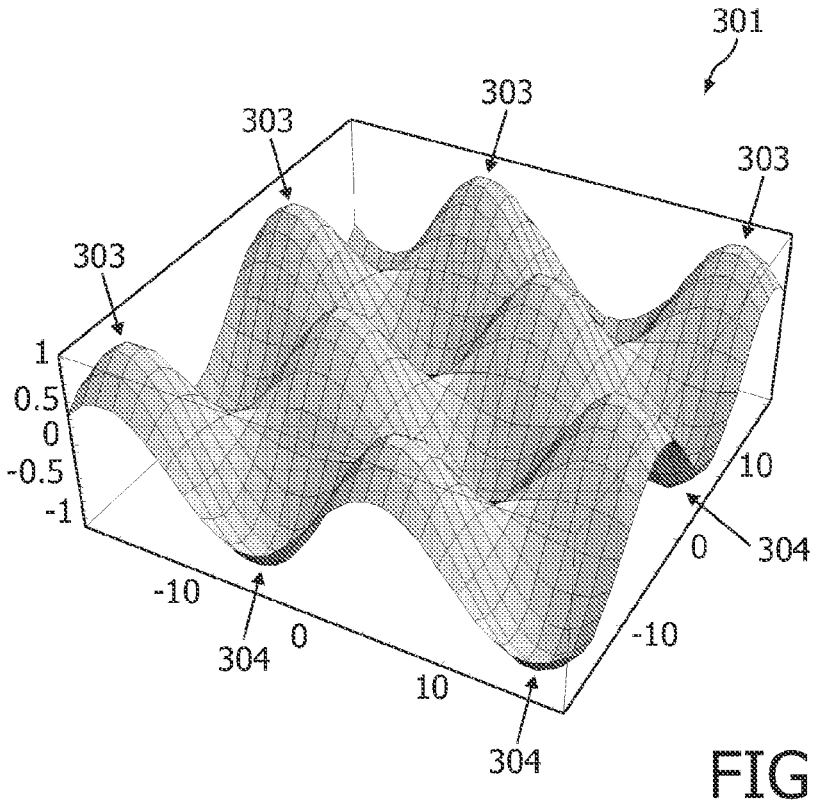

301
303
303
303
303
303
1
0.5
0
-0.5
-1
-10
0
10
304
304
10
0
-10
304

FIG. 6

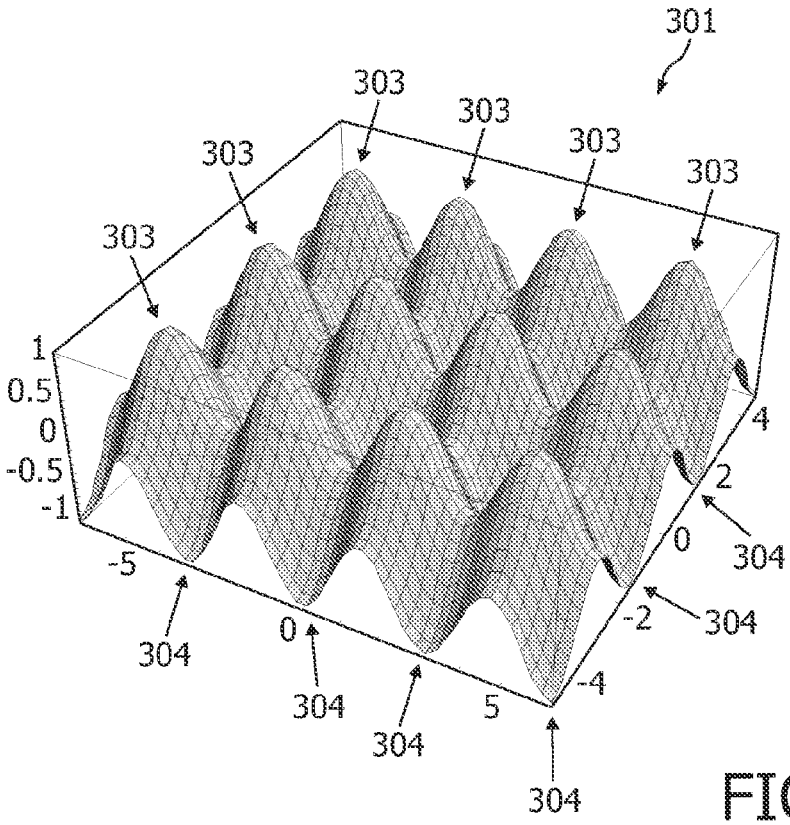

301
303
303
303
303
303
303
1
0.5
0
-0.5
-1
-5
0
5
304
304
304
304
4
2
0
-2
-4
304
304
304

FIG. 7

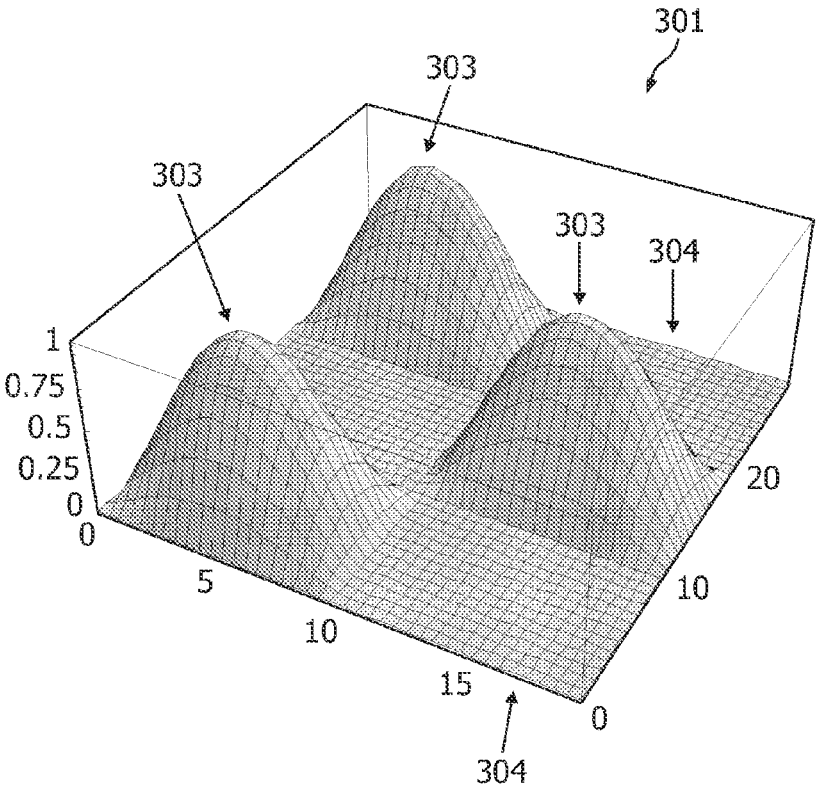

301
303
303
303
304
304
1
0.75
0.5
0.25
0
0
5
10
15
0
10
20

FIG. 8

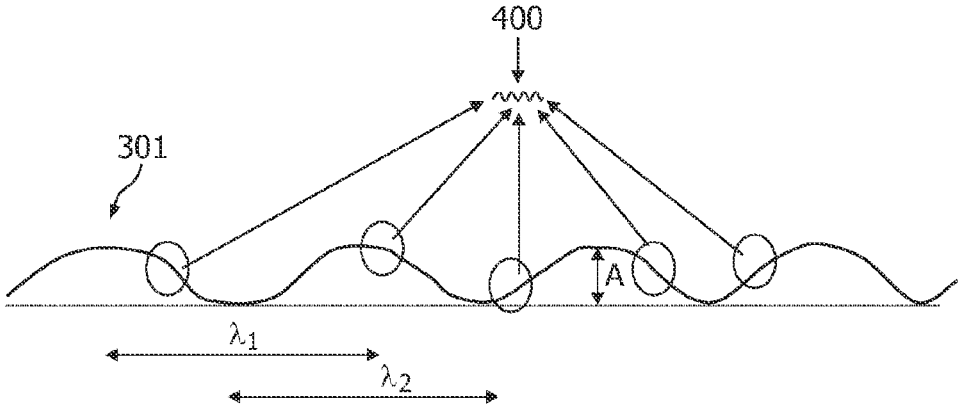

400
301
A
λ_1
λ_2

FIG. 9

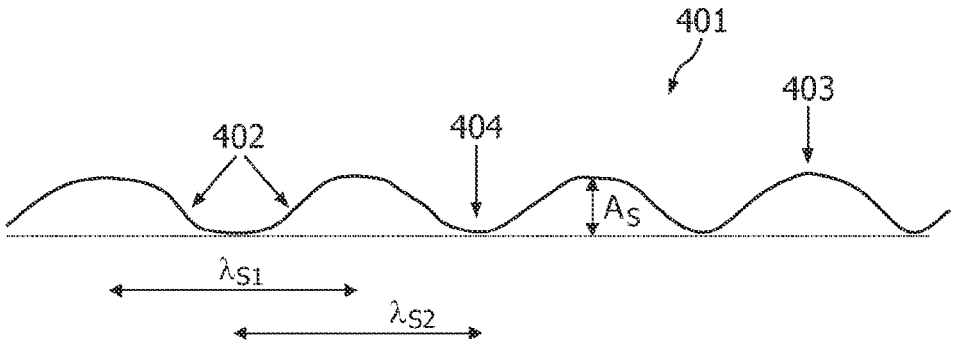


FIG. 10

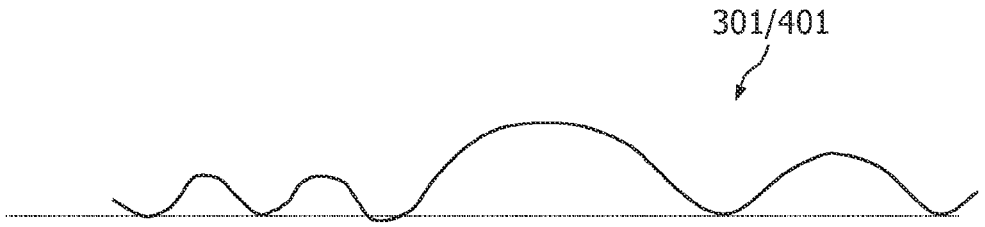


FIG. 11

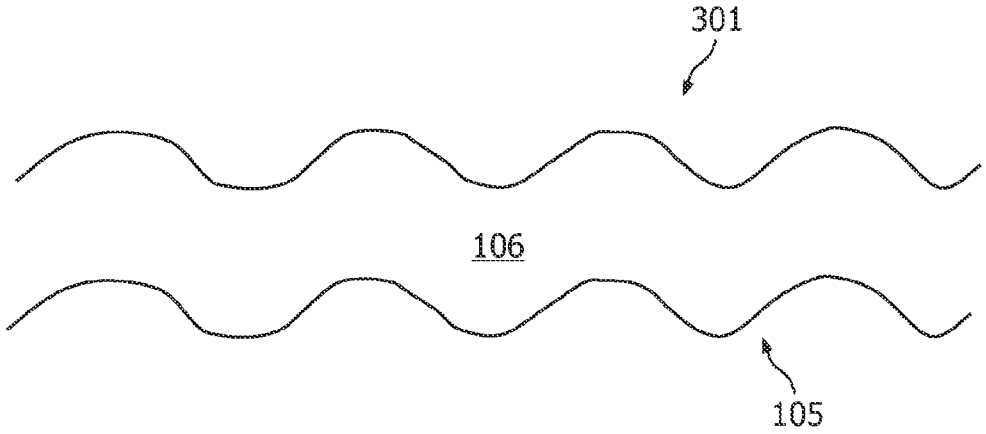


FIG. 12

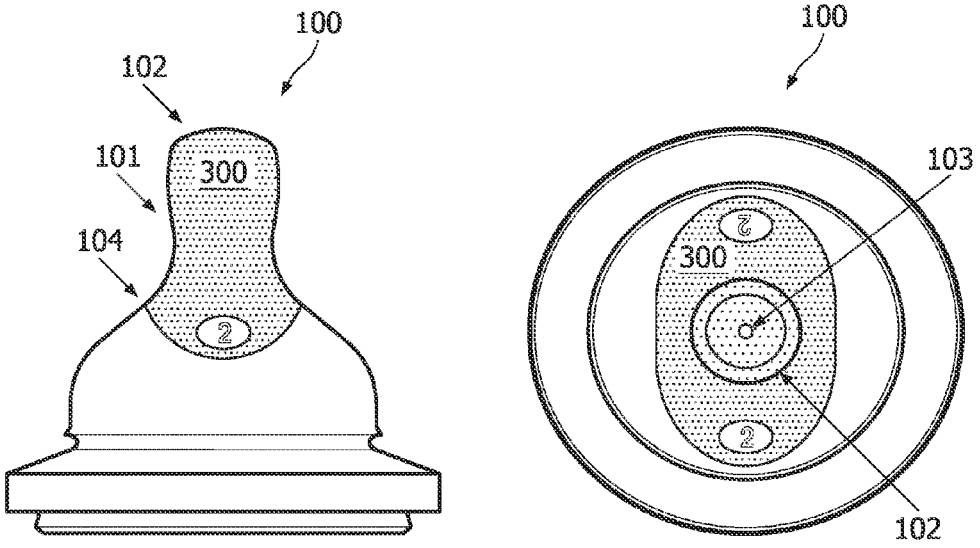

100
102
101
300
104
2
100
103
300
2
2
102

FIG. 13

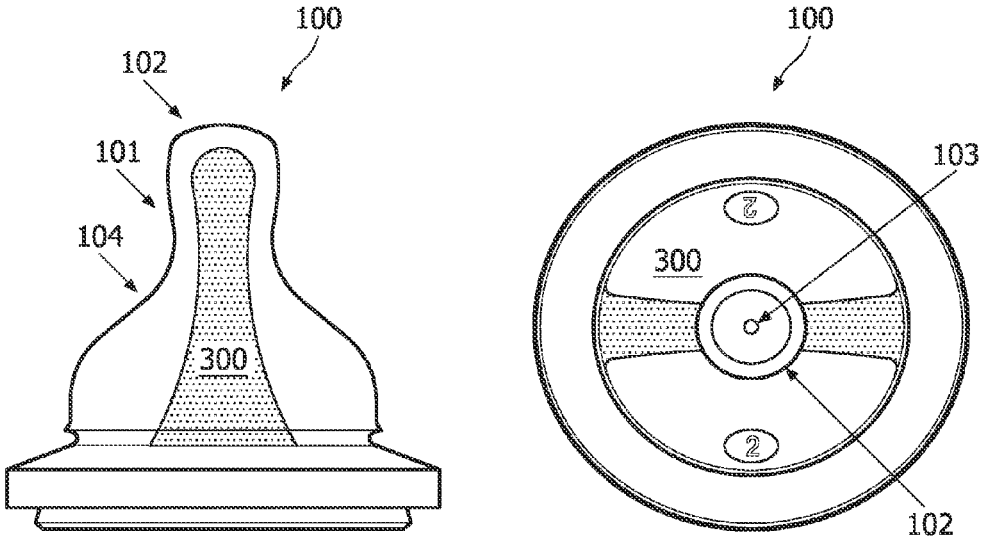

100
102
101
104
300
100
103
2
300
2
102

FIG. 14

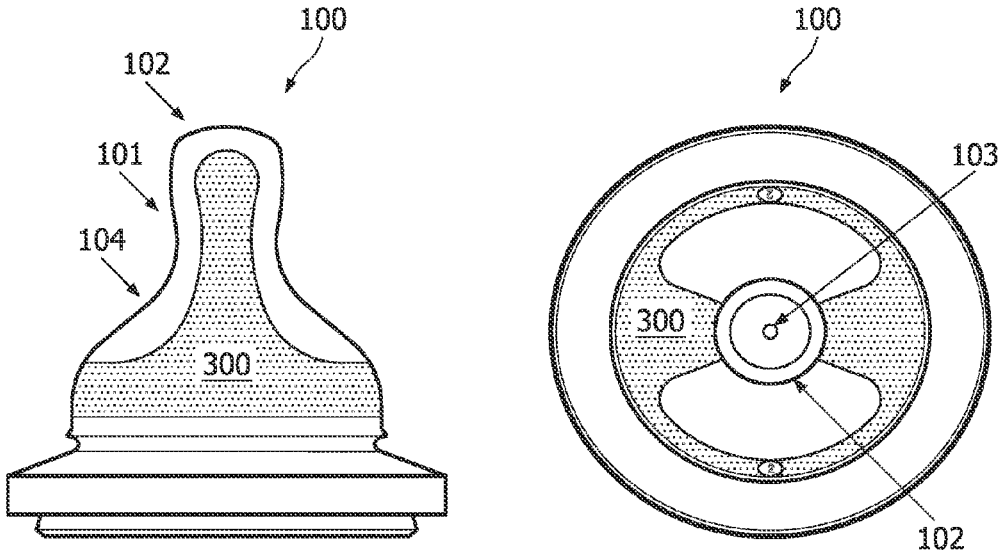


FIG. 15

TEAT

FIELD OF THE INVENTION

The present invention relates to a teat comprising a stem and a nipple, in which a structured area comprising an undulating surface is provided on at least a partial region of the stem or the nipple.

BACKGROUND OF THE INVENTION

Teats are used for artificial feeding and are commonly used with feeding bottles for supplying milk to children. For example, a conventional teat may cooperate with the lid of a feeding bottle to provide a means through which milk stored in the bottle can be supplied to a child.

SUMMARY OF THE INVENTION

It is advantageous for such teats to simulate a mother's breast, as it is known that children generally prefer the experience of feeding from their mother's breast to that of feeding from a conventional teat. It is thought that this preference is due to the differences in shape, texture and appearance between a mother's breast and a conventional feeding teat and, although attempts have made to develop teats to address this problem, conventional and prior art teats have so far insufficiently been able to imitate all of the above characteristics of a mother's breast.

According to the invention, there is provided a teat comprising a stem and a nipple, wherein a structured area comprising an undulating surface is provided on at least a partial region of the stem or nipple, the surface roughness of the undulating surface being greater than 100 μm.

The surface roughness R_z of the undulating surface may be at least 120 μm.

The surface roughness R_z of the undulating surface may be 600 μm or less.

The undulating surface may comprise a plurality of elevated regions and a plurality of depressed regions and the average distance between adjacent elevated regions may be at least 200 μm.

The elevated regions of the undulating surface may have varying geometric properties.

The average distance between adjacent elevated regions may be equal to or less than 20 mm.

The average distance between adjacent elevated regions may be equal to or less than 3 mm.

The average distance between adjacent elevated regions may be equal to or less than 1 mm.

The undulating surface may comprise a secondary structured area comprising a secondary undulating surface.

The secondary undulating surface may comprise a plurality of elevated regions and a plurality of depressed regions.

The average distance between adjacent elevated regions of the undulating surface may be greater than the average distance between adjacent elevated regions of the secondary undulating surface.

The average distance between adjacent elevated regions of the secondary undulating surface may be 100 μm or less.

The elevated regions of the secondary undulating surface may have varying geometric properties.

The structured area may be provided on an external region of a wall of the stem or nipple, and an internal region of the wall may have a profile which substantially matches the profile of the structured area.

The teat may be adapted to cooperate with a feeding bottle.

BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments of the invention will now be described, by way of example, with reference to the accompanying drawings in which:

FIG. **1** is a side-view and a plan-view of a teat having a stem, nipple and structured area, and a teat in cooperation with a lid of a feeding bottle.

FIG. **2** is a two-dimensional representation of a first example of an undulating surface, having a plurality of sloping regions, elevated regions and depressed regions.

FIG. **3** is a three-dimensional representation of a first example of an undulating surface, having a plurality of sloping regions, elevated regions and depressed regions.

FIG. **4** is a two-dimensional representation of a second example of an undulating surface, having a plurality of sloping regions, elevated regions and depressed regions.

FIG. **5** is a three-dimensional representation of a second example of an undulating surface, having a plurality of sloping regions, elevated regions and depressed regions.

FIG. **6** is a three-dimensional representation of a third example of an undulating surface, having a plurality of sloping regions, elevated regions and depressed regions.

FIG. **7** is a three-dimensional representation of a fourth example of an undulating surface, having a plurality of sloping regions, elevated regions and depressed regions.

FIG. **8** is a three-dimensional representation of a fifth example of an undulating surface, having a plurality of sloping regions, elevated regions and depressed regions.

FIG. **9** is a two-dimensional representation of an undulating surface comprising a secondary structured area comprising a secondary undulating surface.

FIG. **10** is a two-dimensional representation of a secondary undulating surface comprising a plurality of sloping regions, elevated regions and depressed regions.

FIG. **11** is a two-dimensional representation of an undulating surface or secondary undulating surface comprising a plurality of sloping regions, elevated regions and depressed regions having varying geometric properties.

FIG. **12** is a two-dimensional representation of the substantially matching profiles of an exterior surface and interior surface of a wall of a teat.

FIG. **13** is a side-view and a plan-view of a teat having a stem, nipple and structured area.

FIG. **14** is a side-view and a plan-view of a teat having a stem, nipple and structured area.

FIG. **15** is a side-view and a plan-view of a teat having a stem, nipple and structured area.

DETAILED DESCRIPTION OF THE EMBODIMENTS

A teat **100** suitable for supplying milk to a baby, infant or child is shown in FIG. **1**. The teat **100** is adapted to cooperate with a feeding bottle **200**, for example by cooperating with a lid **201** of the feeding bottle **200**. The teat **100** may additionally be adapted such that it is easily detached from the lid **201** for cleaning purposes.

As is shown by FIG. **1**, the teat **100** comprises a stem **101** and a nipple **102**, through which milk or other fluid may pass. For example, milk or fluid may pass through one or more feeding openings **103** in the nipple **102** when a pressure difference is created between the interior and

exterior of the nipple **102**. This pressure difference may be created by a child sucking on the teat **100**.

A structured area **300** is provided on at least a partial region of an exterior surface **104** of the stem **101** or nipple **102** of the teat **100**. An example of the structured area **300** is shown by the shaded area in FIG. **1**. The structured area **300** may comprise an undulating surface **301** including a plurality of sloping regions **302**, a plurality of elevated regions **303** and a plurality of depressed regions **304**. A first example of a section of such an undulating surface **301** is shown in two-dimensions and three-dimensions by FIG. **2** and FIG. **3** respectively, in which the sloping regions **302**, elevated regions **303** and depressed regions **304** can be clearly identified.

As is shown by FIG. **3**, the first example of the undulating surface **301** is formed of a plurality of substantially parallel ridges, which are separated from one another by a series of substantially parallel troughs. These ridges and troughs define the sloping, elevated and depressed regions **302**, **303**, **304** of the undulating surface **301**. It should be noted that, for the purposes of clearly showing the sloping regions **302**, the scales of the horizontal and vertical axes in FIG. **3** are substantially different to one another. As such, the gradient of the sloping regions **302** in FIG. **3** is exaggerated.

As is shown by the two-dimensional representation of FIG. **2**, the cross-section of the undulating surface **301** of this first example may substantially correspond to the form of a sine wave.

The vertical distance between adjacent elevated and depressed regions **303**, **304** is represented in FIG. **2** by distance A. An average vertical distance between the elevated regions **303** and depressed regions **304** can be represented in terms of a surface roughness R_z, which is the average of the distance, measured along the vertical axis of the elevated and depressed regions **303**, **304**, between adjacent elevated and depressed regions **303**, **304** of the undulating surface **301**.

The undulating surface **301** may have a surface roughness R_z of greater than 100 μm, and may have a surface roughness of not less than 120 μm. The undulating surface may also have a distance λ_1 between adjacent elevated regions **303** in a range between 200 μm and 20 mm. Alternatively, the distance λ_1 between adjacent elevated regions **303** may be in a range between 200 μm and 3 mm. As a further alternative, the distance λ_1 between adjacent elevated regions **303** may be in a range between 200 μm and 1 mm. The same set of ranges may also apply to the distance λ_2 between adjacent depressed regions **304**. These ranges may additionally apply to any of the alternative examples of the undulating surface **301** discussed below. As is indicated by FIG. **2**, the distances λ_1, λ_2 between adjacent elevated regions **303** and depressed regions **304** are measured perpendicular to the axis of the surface roughness depth R_z.

The undulating surface **301** is smooth to the touch due to the human finger only sensing the elevated regions **303**. The undulating surface **301** also provides the structured area **300** with a very low gliding resistance and increases the similarities in physical appearance between the teat **100** and a mother's breast. The resemblance between the texture, feel and appearance of the teat **100** and the texture, feel and appearance of a mother's breast is thus increased.

When the distances λ_1, λ_2 between adjacent elevated regions **303** and depressed regions **304** are in the ranges discussed above, the structured area **300** of the teat **100** may be to some degree transparent. This is convenient for a user of the feeding bottle **200** with which the teat **100** may be being used, for example a child's mother or father, as it allows the interior of the teat **100** to be viewed without having to remove the lid **201** of the feeding bottle **200**. The user is therefore able to see when the interior of the teat **100** is dirty and requires cleaning.

A second example of a section of undulating surface **301** is shown in two-dimensions and three-dimensions by FIG. **4** and FIG. **5** respectively. As with the first example discussed above in relation to FIGS. **2** and **3**, the undulating surface **301** comprises a plurality of sloping regions **302**, elevated regions **303** and depressed regions **304** defined by a series of parallel ridges and troughs. However, as can be seen from FIGS. **4** and **5**, the troughs defining the depressed regions **304** of this second example are substantially wider than the troughs defining the depressed regions **304** in the first example.

Referring to the two-dimensional representation of the undulating surface **301** shown in FIG. **4**, the cross-section of the undulating surface **301** of the second example may substantially correspond to a discontinuous sine wave, in which the lower half of the sine wave is replaced by a series of flat sections joining adjacent peaks. As such, each of the troughs defining the depressed regions **304** in this example of the undulating surface **301** comprises a substantially flat base region, which is joined at each of its ends to the sloping regions **302**. This example of the undulating surface **301** is advantageous from a manufacturing point of view, as it can be fabricated using a relatively simple mould.

Although FIG. **4** shows the two-dimensional form of the undulating surface **301** as substantially corresponding to the upper half of a sine wave, it will be appreciated that the undulating surface **301** could alternatively correspond to any other proportion of a sine wave. For example, the undulating surface **301** may substantially correspond to the upper quarter or third of a sine wave, with substantially flat sections joining the sloping regions **302**.

A third example of a section of undulating surface **301** is shown in three dimensions by FIG. **6**. As with the examples discussed above, this example of the undulating surface **301** comprises a plurality of sloping regions **302**, a plurality of elevated regions **303** and a plurality of depressed regions **304**. However, as is shown by FIG. **6**, the undulating surface **301** of this example differs from the first and second examples in that the elevated, depressed and sloping regions **302**, **303**, **304** are defined by a pattern of protrusions and depressions rather than a series of ridges and troughs.

The structure of the pattern of protrusions and depressions which define the elevated, depressed and sloping regions **303**, **304**, **302** of this example of the undulating surface **301** is described by the following mathematical function:

$$f(x,y)=\text{Sin } ax\cdot\text{Sin } ay \text{ where } a=0.3 \qquad \text{Equation (1)}$$

Each of the units shown on the xy scale in FIG. **6** may correspond to a distance in a range between 60 μm and 300 μm. Hence the example shown in FIG. **6** may have a surface roughness depth R_z in a range between 120 μm and 600 μm. Alternatively, the example shown in FIG. **6** may have a surface roughness depth R_z in a range between 120 μm and 300 μm.

The distance λ_1 between adjacent elevated regions **303** may be in a range between 1.2 mm and 6 mm. Alternatively, the distance λ_1 between adjacent elevated regions **303** may correspond to any of the distance ranges discussed in relation to the first example of the undulating surface **301**. The same set of ranges may also apply to the distance λ_2 between adjacent depressed regions **304**. As with the first example discussed above, the distances λ_1, λ_2 between adjacent elevated regions **303** and depressed regions **304** are

measured perpendicular to the axis of the elevated and depressed regions **303**, **304** in a manner corresponding to that shown in FIG. **2**.

Alternatively, the structure of the protrusions and depressions which define the elevated and depressed regions **303**, **304** may correspond to any other combination of the product of Sin x and Sin y. For instance, referring to FIG. **7**, a fourth example of a section of an undulating surface **301** is shown in which the structure of the pattern of protrusions and depressions is described by the function:

$$f(x,y)=\mathrm{Sin}(x+y)\cdot\mathrm{Sin}(x-y) \qquad \text{Equation (2)}$$

This example has the advantage that, from whatever angle the undulating surface **301** is viewed, the surface roughness depth R_z and distances λ_1, λ_2 are always constant.

A fifth example of a section of an undulating surface **301** is shown in three dimensions in FIG. **8**. This example of the undulating surface **301** differs from the third and fourth examples discussed above in that the depressed regions **304** correspond to substantially flat sections which join the sloping regions **302**. In this regard, this example of the undulating surface **301** is similar to the second example discussed in relation to FIGS. **4** and **5**. The structure of the elevated regions **303** of this example of the undulating surface **301** may correspond to those shown in FIG. **6** or FIG. **7**, or may be described by any other combination of the product of Sin x and Sin y as previously discussed. The magnitude of the surface roughness R_z and distances λ_1, λ_2 may correspond to any those discussed in the previous examples.

The surface area of the protrusions defining the elevated regions **303** relative to the surface area of the substantially flat sections defining the depressed areas **304** can be varied as described in relation to FIG. **4**. There is no requirement for the pattern of protrusions and depressions to be symmetrical as shown in FIG. **8**.

Referring to FIGS. **9** and **10**, any of the first to fifth examples of the structured area **300** comprising an undulating surface **301**, discussed above in relation to FIGS. **2** to **8**, may additionally comprise a secondary structured area **400**.

The secondary structured area **400** may be provided on the undulating surface **301**, and may comprise a secondary undulating surface **401** including a plurality of sloping regions **402**, a plurality of elevated regions **403** and a plurality of depressed regions **404**.

The form of the secondary undulating surface **401** may, for example, correspond to the form of any of the examples of the undulating surface **301** discussed above in relation to FIGS. **2** to **8**. The surface roughness R_{sz} and distances λ_{S1}, λ_{S2} between adjacent elevated regions **403** and depressed regions **404** of the secondary undulating surface **401** may, however, be smaller than those discussed in relation to the examples of the undulating surface **301**.

For example, the distance λ_{S1} between adjacent elevated regions **403** may be of 100 μm or less. Alternatively, the distance λ_{S1} between adjacent elevated regions **403** may be in a range between 0.1 μm and 400 μm. The distance λ_{S2} between adjacent depressed regions **404** may be of an equivalent, or approximately equivalent, value to the distance λ_{S1}. The surface roughness R_{sz} of the secondary undulating surface **401** may be in a range between 0.2 μm and 10 μm. The definitions of R_{sz}, λ_{S1} and λ_{S2} substantially correspond to the definitions of R_z, λ_1 and λ_2 given in relation to the first example of the undulating surface **301** discussed above.

The secondary undulating surface **401** may be formed over the entire undulating surface **301**, or may be formed over only a partial region thereof.

The combination of the undulating surface **301** and secondary undulating surface **401** further contributes to the overall smooth feel and low gliding resistance of the structured area **300**, and increases the resemblance between the texture, feel and appearance of the structured area **300** and the texture, feel and appearance of a mother's breast.

The secondary structured area **400** may be formed during manufacture of the teat **100** using techniques such as sand-blasting or chemical etching. The location of the secondary structured area **400** may be at the nipple **102** of the teat **100**, such that the area **400** is in contact with the mouth of the baby or child during feeding.

In relation to all examples of the undulating surface **301** and secondary undulating surface **401** discussed above, the geometric properties of the elevated regions **303**, **403** and depressed regions **304**, **404** may be substantially uniform as is shown, for example, in FIGS. **6** and **7**. It should be noted, however, that this is not a requirement of the invention. The elevated regions **303**, **403** of any particular example may vary in height and width, and may also be of varying distances apart from one another. The same is true of the depressed regions **304**, **404**.

An example of an undulating surface **301** or secondary undulating surface **401** exhibiting such varying geometric properties is shown in FIG. **11**.

The interior surface **105** of the teat **100** may comprise a plurality of strengthening elements, for example comprising standard ribbed sections as known in the art. The interior surface **105** of the teat **100** may otherwise be of a substantially flat profile.

Alternatively, the profile of the inner surface **105** of the teat **100** may be of any other form. For example, the profile of the interior surface **105** of the teat **100** may undulate so as to follow the profile of the undulating surface **301** of the structured area **300** on the exterior surface **104** of the teat **100**, thus keeping the wall **106** of the teat **100** at a constant, or substantially constant, thickness. This is shown in FIG. **12**. Creating a teat wall **106** of substantially constant thickness in this manner may increase the strength and durability of the teat **100**, and thus may be advantageous.

The teat **100** may be manufactured as a complete unit, for example using a mould, from any suitable material. Suitable materials may include, for example, silicone, latex or thermoplastic elastomers (TPE) such as TPE-A or TPE-S. The Shore hardness of the teat **100** may be in a range between 5 and 70 Shore A. Alternatively, the Shore hardness may be in a range between 30 and 50 Shore A.

Referring again to FIG. **1**, a first example coverage region of the structured area **300** on the exterior surface **104** of the teat **100** is shown. FIGS. **13** to **15** show second, third and fourth example coverage regions of the structured area **300**. As can be seen, in all of these examples, the structured area **300** is provided on at least a partial region of the stem **101** or nipple **102**. The areas of the exterior surface **104** of the stem **101** or nipple **102** on which the structured area **300** is not provided may be substantially smooth.

Although the teat **100** has been described in relation to supplying milk or fluid to humans, it will be appreciated that the teat **100** could alternatively be used for supplying milk to other mammals. In addition, although the teat **100** has been substantially discussed in relation to feeding, it will be appreciated that it is equally applicable for use with a pacifier or other products which are to be used orally by a child.

Although claims have been formulated in this application to particular combinations of features, it should be understood that the scope of the disclosure of the present invention also includes any novel features or any novel combination of features disclosed herein either explicitly or implicitly or any generalisation thereof, whether or not it relates to the same invention as presently claimed in any claim and whether or not it mitigates any or all of the same technical problems as does the present invention. The applicants hereby give notice that new claims may be formulated to such features and/or combinations of such features during the prosecution of the present application or of any further application derived therefrom.

The invention claimed is:

1. A teat comprising a stem and a nipple, wherein a structured area comprising a primary undulating surface is provided on at least a partial region of the stem or nipple, wherein the primary undulating surface is sinusoidal and has a surface roughness Rz of greater than 100 μm, wherein the primary undulating surface comprises elevated regions and depressed regions, and wherein the primary undulating surface comprises one or more secondary structured areas located only along the sinusoidal shape of the primary undulating surface, wherein the one or more secondary structured areas comprise a secondary undulating surface comprising a plurality of sloping regions, a plurality of elevated regions and a plurality of depressed regions,

wherein an average distance between adjacent elevated regions of the primary undulating surface is greater than an average distance between adjacent elevated regions of the secondary undulating surface; and

wherein a height between an elevated region and a depressed region of the secondary undulating surface is less than a height between an elevated region and a depressed region of the primary undulating surface.

2. The teat according to claim **1**, wherein an average distance between adjacent elevated regions of the secondary undulating surface is 100 μm or less.

3. The teat according to claim **1**, wherein the elevated regions of the secondary undulating surface have varying geometric properties including different heights.

4. The teat according to claim **1**, wherein the teat is adapted to cooperate with a feeding bottle.

* * * * *